

SYSTEM AND METHOD FOR SUPPLYING CONSUMERS
WITH HEAT ENERGY OR WITH COOLING ENERGY

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Cross-Reference to Related Application:

This application is a continuation of copending International Application No. PCT/AT02/00190, filed June 28, 2002, which designated the United States. The application also claims the
10 benefit under 35 U.S.C. § 119 of Austrian patent application A. 1168/2001, filed July 26, 2001; these disclosures are herewith incorporated by reference in their entirety.

Background of the Invention:

15 Field of the Invention:

The present invention relates to a system and to a method for supplying consumers with heat energy or with cooling energy by means of a transfer medium, having at least one source for heat energy or for cooling energy, the output line of which
20 source is placed at the input to at least one controllable distributor device which is assigned to said source and which is designed with a multiplicity of outputs to which the forward-flow lines to consumers of heat energy or of cooling energy at different temperature levels are connected, it being
25 possible for the distributor device to select one of the

consumers to which transfer medium at the required temperature level can be supplied.

A system of that type is disclosed in my earlier U.S. Patent
5 No. 5,788,149 and the corresponding European patent EP 0711958
B1. In that earlier system, the consumers of heat energy or of
cooling energy at different temperature levels are connected
in series. This enables the heat energy which is not required
by a consumer at a given temperature level to be passed on in
10 each case to the consumer which is connected downstream of it
and has a lower temperature level. The heat energy which is
not required by any of the consumers connected in series and
having different temperature levels is finally output to a
heat reservoir, from which the heat energy is drawn off and
15 raised again, by means of a heat pump, to such a temperature
level that it can be supplied to one of the consumers having a
high temperature level.

The prior art system does not therefore entirely meet the
20 requirements, as the heat energy which has a given temperature
level and is not immediately required in the associated
consumer is supplied to the consumer that is connected
downstream and has a lower temperature level. Since the
temperature of that heat energy is reduced as a result, it is
25 consequently no longer available with the consumers having a
higher temperature level.

Summary of the Invention:

It is accordingly an object of the invention to provide a device and a method for supplying heat energy or cooling
 5 energy to consumers, which overcomes the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and which provides a system of this type that allows that thermal energy which is at a given temperature level and is not immediately required by the
 10 associated consumer can also be supplied to said consumer at a later time, namely as soon as it is required

With the foregoing and other objects in view there is provided, in accordance with the invention, a system for
 15 supplying consumers with heat energy or with cooling energy, comprising:

at least one source for heat energy or for cooling energy, and an output line communicating with said source;

a controllable distributor device with an input connected to
 20 said output line of said source and with a plurality of outputs connected to forward-flow lines for selectively supplying heat or cooling energy via a transfer medium at mutually different temperature levels to a given consumer at a respectively required temperature level;

at least one heat reservoir connected in parallel with each of
a plurality of the consumers at mutually different temperature
levels, wherein said heat reservoir is configured to store
excess heat energy at a given temperature level and to supply
5 heat energy content contained therein to the consumer at the
given temperature level.

In other words, the objects of the invention are achieved by
the fact that at least one heat reservoir is connected in
10 parallel in each case with at least some of the consumers for
heat energy at different temperature levels, it being possible
for the excess heat energy to be stored in said heat reservoir
at the given temperature level and for the heat energy
contained therein to be removed from it and to be supplied to
15 the consumer at the relevant temperature level.

Preferably, a plurality of consumers for heat energy at
different temperature levels are provided in a manner known
per se, a heat reservoir being connected in parallel with each
20 of these consumers. Furthermore, the source for cooling energy
is preferably formed in a manner known per se by at least one
environmental collector and by a heat pump, and a store for
cooling energy is likewise assigned to the at least one
consumer for cooling energy.

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According to one preferred embodiment, shut-off valves are connected between the forward-flow lines for feeding heat energy and cooling energy into the associated consumers. This enables heat energy to be placed into the system and stored
 5 therein and also enables cooling energy to be supplied to the consumers in order to bring about air conditioning. Reversing valves are preferably connected into the forward-flow lines for feeding heat energy and cooling energy into walls, said reversing valves being used to supply the walls with heat
 10 energy from below and cooling energy from above.

According to a furthermore preferred embodiment, lines directly connecting the consumers for different temperature levels, which consumers are connected in series between the
 15 return lines and the forward-flow lines, are provided, and the forward-flow line of the distributor device can be connected to the forward-flow line of the consumer having the highest temperature level and the return line of the distributor device can be connected to the return line of the consumer
 20 having the lowest temperature level. According to the method according to the invention, the thermal energy which is output by the source for heat energy or for cooling energy and which is not required by the consumers is output to at least one of the thermal stores connected in parallel with the consumers of
 25 different temperature level and is stored in said store, and, if the need arises, in particular after a heating furnace

located in the system or the heat pump is switched off, thermal energy is removed from the store and supplied to consumers.

5 The text herein refers to supplying "heat energy" and supplying "cooling energy." In purely thermodynamic terms, of course, supplying cooling energy is to be understood as removing heat energy or heat content from a system. The underlying changes, by convention, are parameterized with +Q
10 and -Q and the corresponding entropy changes of the systems - here, consumers - are substantially equal and opposite as well.

Other features which are considered as characteristic for the
15 invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a system and method for supplying consumers with heat energy or with cooling energy, it is nevertheless not
20 intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

25 The construction and method of operation of the invention, however, together with additional objects and advantages

thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

5 Brief Description of the Drawing:

The sole figure of the drawing is schematic illustration of a system according to the invention.

Description of the Preferred Embodiments:

10 Referring now to the figure of the drawing in detail, a system according to the invention contains a plurality of devices for outputting heat energy or cooling energy, namely a heating furnace 1, two solar or environmental collectors 2 and 3 and a heat pump 4. Heat energy or cooling energy at different
15 temperature levels is output by these devices 1 to 4 by way of a heat transfer medium. In this case, heat energy at a temperature in the range of from 95°C to 30°C is output by the heating furnace 1, heat energy or cooling energy in the range of 100°C to -40°C is output by the collectors 2 and 3 as a
20 function of the climatic conditions and heat energy or cooling energy of 50°C to -20°C is output by the heat pump 4.

A plurality of consumer circuits I to V which require different temperature levels are connected to the producers of
25 heat energy or of cooling energy. These constitute a first heating circuit I for a space heating system, for example

using radiators, furthermore a second heating circuit II for an inside-wall heating system, furthermore a third heating circuit III for a floor heating system, furthermore a fourth heating circuit IV for an outside-wall heating system and
 5 finally a cooling system V and a cold reservoir Vb.

The heating furnace 1 is connected via lines 11 and 11a only to the first consumer circuit I for the space heating system. In contrast, the collectors 2 and 3 and the heat pump 4 are
 10 connected via distributor devices 20, 30, 40 and 50 to the consumer circuits I to V. Thus, the distributor device 20 is connected via a forward-flow line 21 and a return line 21a to the consumer circuit I and via further forward-flow lines 22 to 25 and return lines 22a to 25a to the consumer circuits II
 15 to V. The distributor devices 30, 40 and 50 are also connected to the consumer circuits I to V in the same manner.

The heat energy or cooling energy made available by the heat generators or cold generators through the distributor devices
 20 20, 30, 40 and 50 and having different temperature levels is supplied in each case to the particular consumer circuit I to V in which the relevant temperature level is required. For this purpose, mixing devices M and pumps P are provided in the individual consumer circuits.

The transfer medium is supplied by the distributor devices 20, 30, 40 and 50, as a function of the temperature which the transfer medium output by the associated heat source or cold source has, via one of the forward-flow lines to the particular consumer circuit which is set to the temperature level. The pump P which is provided in the relevant consumer circuit is used to supply the transfer medium via a mixer M to the at least one consumer which is located in this circuit. The return from this consumer is connected, on the one hand, to the mixer and takes place, on the other hand, via the associated return line, via which the cooled transfer medium is conducted further.

If, in a system of this type, the heat energy supplied to one of the consumer circuits is not required at the corresponding temperature level, it is not, however, conducted further to the consumer circuit which is connected downstream and has a lower temperature level, but rather it is stored at this temperature level. For this purpose, at least one storage device Ia to Va, in which that portion of heat energy or of cooling energy which is not required in the associated consumer circuit I to V is stored, is connected to the distributor devices 20, 30 and 40 in parallel with the consumer circuits I to V. As soon as heat energy at the required temperature level is therefore no longer supplied by one of the distributor devices to the relevant consumer

circuit, since it is not made available by the associated heat source, the relevant forward-flow line is closed and the pump P located in this consumer circuit feeds in heated transfer medium from the associated store. Accordingly, the heat energy
 5 having the given temperature level required for this consumer is removed from the store assigned to this consumer circuit. The same also applies to the cooling energy.

As can be seen from the drawing, the heating furnace 1 is
 10 connected via the lines 11 and 11a only to the heating circuit I and to a boiler Ia for hot water. The heating circuit I is supplied by the collectors 2 and 3 and, if the need arises, by the heat pump 4 provided that they output heat energy at the required temperature level. Excess heat energy occurring in
 15 this case is stored in the boiler Ia. If the required heat energy is not made available by the collectors 2 and 3, it is referred from the heating furnace 1. Heat energy output by the latter is likewise stored in the boiler Ia. As soon as the heating furnace 1 has been switched off and heat energy
 20 continues to be required in this consumer circuit, this heat energy is taken from the boiler Ia. This produces a decisive reduction in the number of times that the heating furnace 1 is switched on and off, as a result of which the requirements in this respect in terms of instructions relating to
 25 environmental protection are satisfied.

The operation of the system is explained below with reference to the environmental collector 2 and the devices connected downstream of the latter:

5 The transfer medium output by the collector 2 is supplied by the distributor device 20 as a function of the temperature of said medium via the forward-flow lines 21 to 25 to one of the consumer circuits I to V. For example, the distributor device 20 outputs transfer medium at a temperature of approximately
10 70° via the forward-flow line 21 to the forward-flow lines 211 and 212 of the first consumer circuit I. The transfer medium passes via the forward-flow line 211 into the consumer circuit I having space heaters and passes via the line 212 into the store Ia. The cooled transfer medium can return via the lines
15 211a and 212a to the return line 21a and to the distributor device 20.

However, as soon as there is no longer any flow from the distributor device 20 into the consumer circuit I, the
20 required heat energy is supplied to the consumer circuit I from the store Ia via the lines 212 and 211. The consumer circuit I is therefore supplied with heat energy from the boiler Ia. In an analogous manner, heat energy at a temperature of approximately 40°C is supplied to the consumer
25 circuit II and to the store IIa assigned thereto, heat energy at a temperature of approximately 30°C is supplied to the

consumer circuit III and the store IIIa, heat energy at a temperature of approximately 20°C is supplied to the consumer circuit IV and to the store IVa, and thermal energy at a temperature of approximately 12°C is supplied to the consumer
 5 circuit V by the boiler Va.

In the situation in which, in contrast, heat energy is no longer required in the consumer circuit I and in the consumer Ia, the distributor device 20 can be adjusted in such a manner
 10 that although the forward flow takes place via the line 21, in which case the transfer medium passes through the boiler Ia, the return takes place via the line 25a. In order to make this possible, the line 212a is connected via a connecting line 213 to the forward-flow line of the consumer circuit II, and the
 15 further consumer circuits III, IV and V are also connected to one another via the lines 223, 233 and 243. This means that the transfer medium passes through all of the consumer circuits I to V, in which case it outputs the heat energy contained in it to the consumers or to the stores having a
 20 lower temperature level in each case. Since it is returned in this manner via the return line 25a at a very low temperature back to the collectors 2 and 3, a very high degree of efficiency is thereby obtained in them.

25 The feeding of the consumer circuits II to IV and of the stores IIa to IVa by the environmental collector 3 and by the

heat pump 4 also takes place in an analogous manner via the distributor devices 30 and 40. For the situation in which, in one of the consumer circuits or one of the associated stores, heat energy at the temperature level corresponding to these consumer circuits or stores is not required, the consumer circuits II to V are also connected to one another via the lines 223, 233 and 243.

Cooling energy can also be output by the environmental collectors 20 and 30 and by the heat pump 40. Cooling energy is conducted by the distributor devices 20, 30, 40 and 50 via the forward-flow lines into the cooling space V or into the cold store Vb and stored in the latter. The cooling energy which is stored in the cold store Vb and also the cooling energy which is output by the heat pump 4 can be output via the distributor device 50 to one of the consumer circuits I to IV, it being used to cool the rooms, the inside walls and floors. For this purpose, shut-off valves 10 are arranged in the consumer circuits I to IV and can be used, in the event of air conditioning taking place, to separate the consumer circuits I to V into two regions in each case, as a result of which at the same time cooling can take place in the consumer circuits I to IV and heat energy can be stored in the stores Ia and Va.

Since the supplying of a wall heating system with heat energy has to take place in such a manner that the heat energy is supplied to the lower end of the wall, whereas cooling has to take place in such a manner that the cooling energy is
 5 supplied to the upper end of the wall, a control valve S is also provided in the consumer circuit II and can be used for the control required for this.

If the distributor devices 20 and 30 are appropriately
 10 controlled, they can also be used to conduct heated transfer medium from the consumer circuits I to V via the forward-flow lines 21, 22, 23 and 24 and through the collectors 2 and 3 in order to free the latter from snow or ice.

15 If heat energy is supplied to the consumer circuit V, said heat energy is conducted into the boiler Va in which water is heated, the hot water consequently being conducted into the boiler Ia, from which heated water for use can be removed.

20 The distributor device 50 can be used to remove heat energy from one of the consumer circuits II to V, said heat energy being supplied to the heat pump 4. The heat energy produced in the heat pump 4 can be supplied via the distributor device 40 to one of the consumer circuits I to V. In addition, the
 25 cooling energy produced by the heat pump 4 can be supplied via

the distributor device 50 to one of the consumer circuits I to V.